



Round : Forensic medicine.....

Group no : A4.....

Done By : Batool ALzubaidi.....

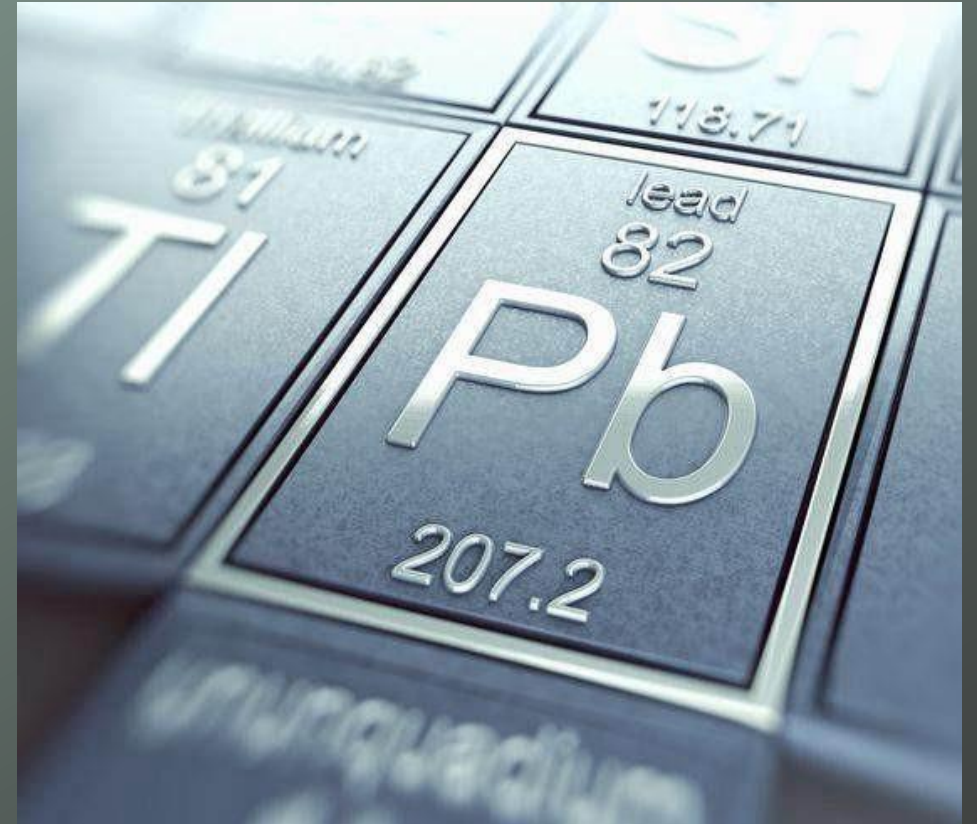
LEAD POISONING

Presented by:
Shefa' Alma'aitah
Batool Jaber
Leen Alwredat

CAUTION LEAD HAZ

What is lead

- Lead is a chemical element with symbol **Pb** and atomic number 82.
- It is a dense, heavy metal.
- Lead's chemical symbol – Pb – comes from the Latin word **Plumbum**.



Description

- Lead is a bluish-white metal of bright luster.

مرن قابل للطرق مقاوم للصدأ

- Lead is a soft, malleable and corrosion resistant material.

Pb

82



Lead



Uses

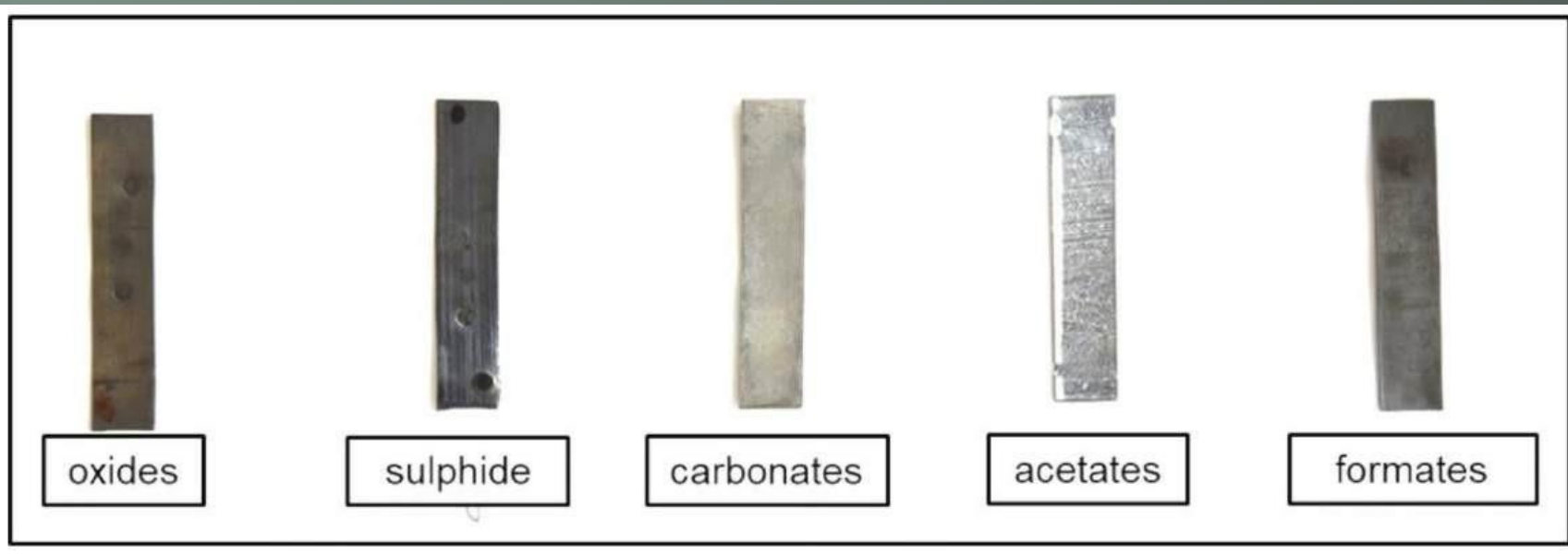
قنوات المي مطلية من جوا بالرصاص

- making **water pipes**, some of which are still in use today.
- lining **tanks** that store corrosive liquids, such as sulfuric acid.
- **shield against X-ray and gamma-ray radiation** and is used in X-ray machines and nuclear reactors. 

لانه high density ف بضعف الاشعة لما تصطدم فيه و لانه اله high
autonomic number بمتص كثير من الاشعة لانه عنده بروتونات كثير
- covering on some wires and cables to protect them from corrosion.
- Most of the lead used today is used in the production on **lead-acid storage batteries**, such as the batteries found in automobiles.
- Production of **paint pigments**.

Compounds

- Lead acetate
- Lead carbonate
- Lead tetraoxide
- Lead sulphide
- Lead oxide
- Lead oleate
- Tetra-ethyl lead



Lead Crisis

- Iraq War and the Syrian Civil War, the use of lead- containing ammunition and explosives can lead to contamination of soil and water, posing health risks to local populations.
- Gaza Strip
- Kabwe lead pollution- began during the early 20th century
- Flint water crisis -2014

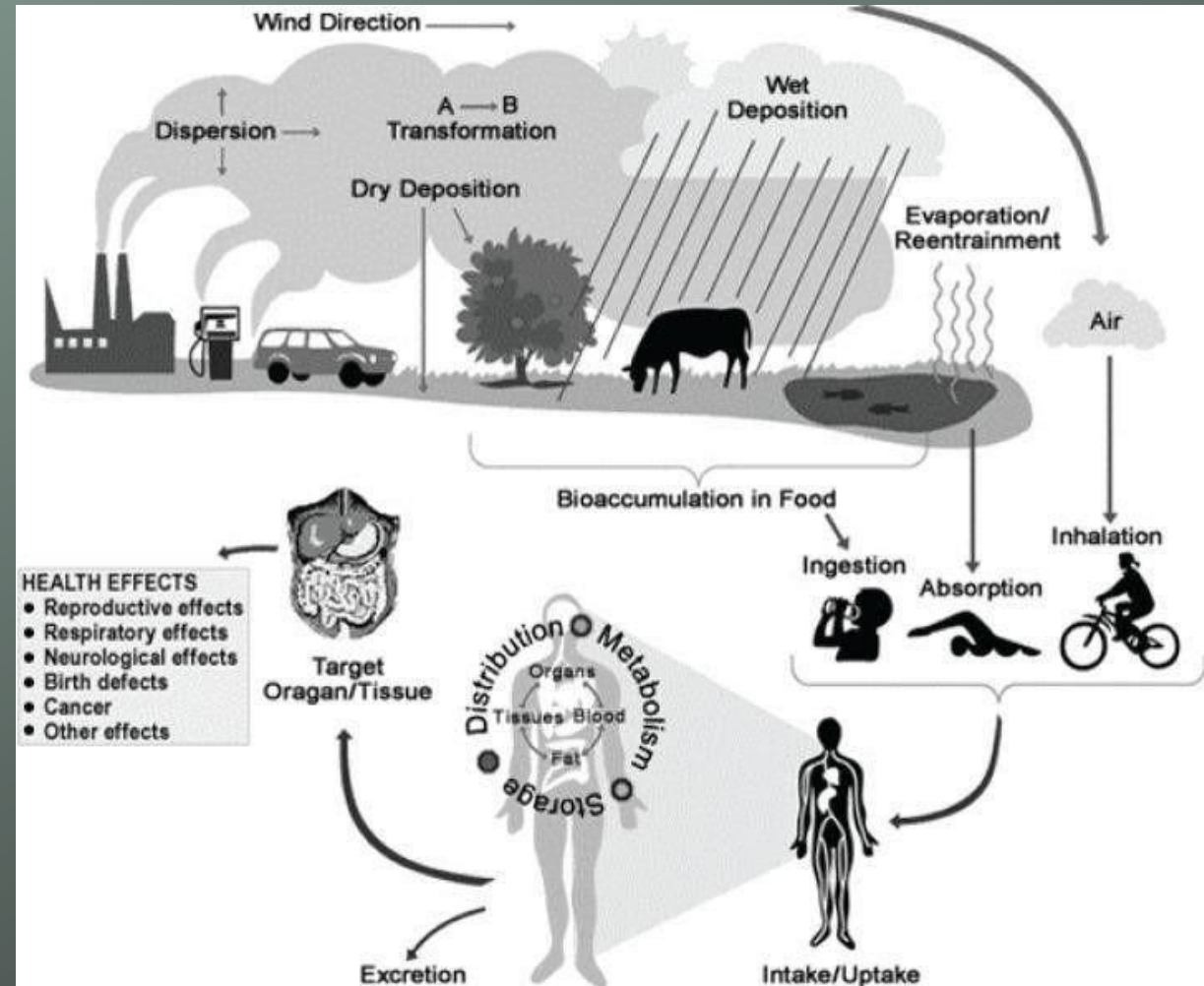


Properties of the element

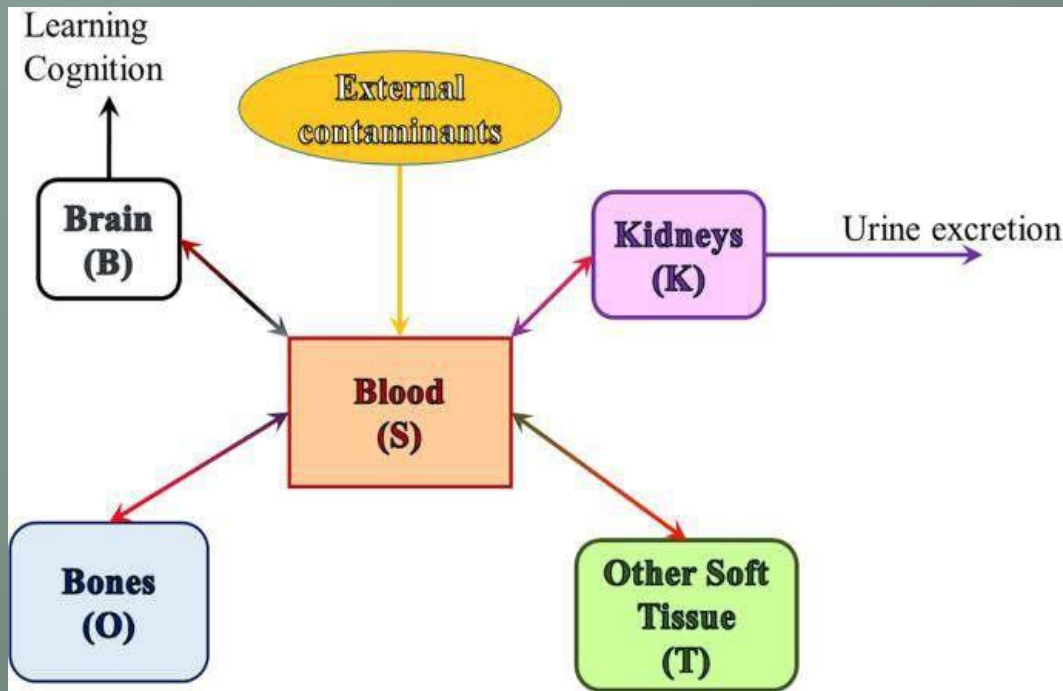
Lead is normally present in almost all human tissues.

Lead and its **compounds** are **toxic** and are retained by the body, **accumulating over a long period of time**, a phenomenon known as :

cumulative poisoning, until a lethal quantity is reached.



Lead poisoning



- Tops the list of heavy metals as far as the chronic poisoning is concerned
- Plumbism/saturnism : chronic Lead poisoning
- Elemental lead and inorganic lead compounds are absorbed through ingestion, inhalation or absorption.

Metabolism

- 1. • In the blood, about 95–99% of lead is sequestered in red cells, half-life (25 days).
- 2. • The largest proportion of absorbed lead is incorporated into the skeleton, which contains > 90% of the body's total lead burden, half life (>25 years).
- 3. • Lead half life in soft tissues is about 40 days.
- Lead is excreted mainly in the urine and in the faeces.
- Lead also appears in hair, nails, sweat, saliva and breast milk.

Toxicity of lead

- Lead interferes with **mitochondrial oxidative phosphorylation** and **sodium, potassium and calcium ATPases**.
- Lead **depresses** the enzymes responsible for **heme synthesis** by:
 - blocking the enzyme aminolevulinic acid dehydratase
 - inhibits ferrochelatase

Resulting in anemia

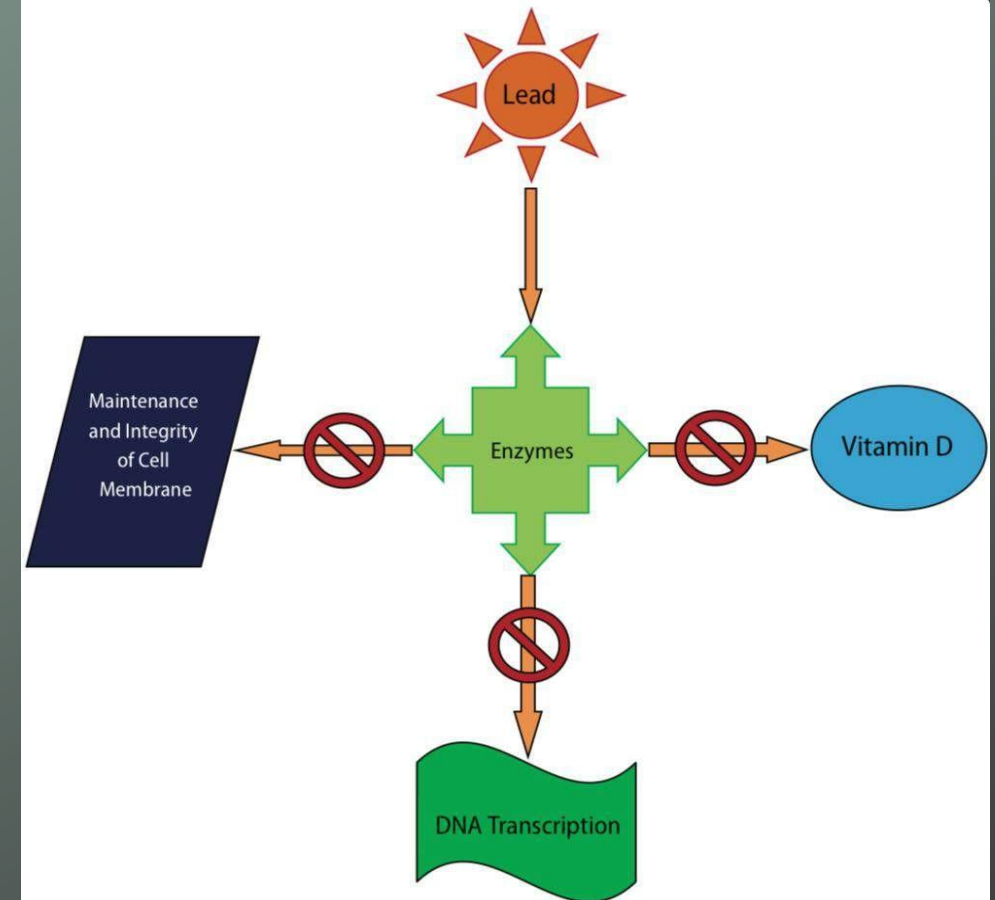
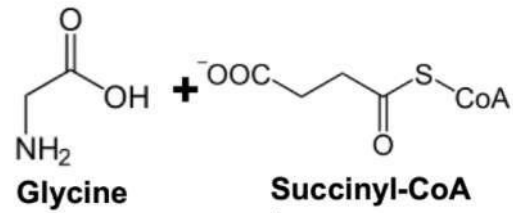


Figure 3. Illustration of the action of lead on enzymes, leading to the disruption of vitamin D synthesis, maintenance of cell membrane and DNA transcription.

Heme Synthesis



ALA Synthase

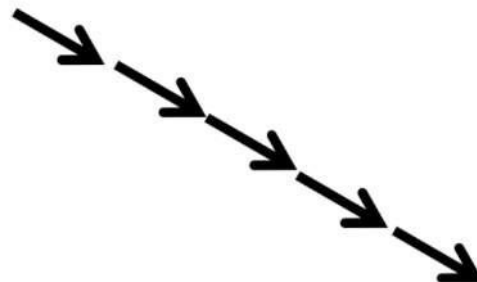
2 Aminolevulinic Acid

Lead

ALA Dehydratase

Zn^{2+}

4 Porphobilinogen

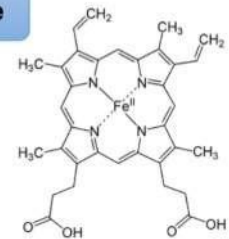


Protoporphyrin IX

Lead

Ferrochelatase

Fe^{2+}



Heme

Possible pathway of lead poisoning

- Poisoning due to lead occurs mainly by **ingestion of food or water contaminated with lead.**

بيعمل flakes and dust الي ممكن يستنشقوهم اهل البيت او يوصل ل اكلهم او ياكلوهم الاطفال عن طريق الخطا

- **Accidental ingestion of contaminated soil, dust or lead based paint.**

تكون المناطق الزراعية قريبة من المصانع

- Lead toxicity may be caused through fruits and vegetables contaminated with high lead levels from the soils where they were grown.
- Lead from **water pipes** coming into homes is one of the major sources.

Possible pathway of lead poisoning

- Occupational exposure :

Radiation shields, ammunition, certain surgical equipment, developing dental X-ray films prior to digital x-rays, fetal monitors, circuit boards, jet engines, and ceramic glazes, lead miners and smelters, plumbers and fitters, car mechanics, glass manufacturers, construction workers, battery manufacturers and recyclers, firing range instructors, and plastic manufacturers are at risk for lead exposure.



Acute Poisoning

When a person ingests or is exposed to a large amount of lead over a short period of time

1. It is very rare, the only common soluble salt is the acetate and this is dangerous only in large doses.

اسرع compound فيه رصاص الجسم بمتصه

2. The average lethal dose is said to be 10 gm/70 kg for most lead salts, while it is 100 mg/kg for tetra-ethyl lead.

هو organic lead موجود بمشتقات البنزين و البترول

اكثر compound فيه رصاص سمية

3. Fatal period may extend to 1–3 days.

Acute poisoning – symptoms

- **Metallic astringent taste** in the mouth

لأنه يتفاعل مع ال oral mucosa

ردّة فعل طبيعية من الجسم عشان يتخلص من السم

- **Vomiting** associated with **colic-like pains** in abdomen.

لأنه يعمل interference مع ال function of smooth muscle cells و بخرّب ال tone تاعها

- There may be purging, more usually **constipation**.

لما يكون بالجهاز الهضمي بتفاعل مع بعض مكوناته و بعمل compounds زي

لأنه يعمل renal toxicity و ممكن يوقف ال

urination او يقلل ال urine production

- The faeces are offensive and black due to formation of lead sulphide and the urine is suppressed.

- Cramps in legs and **arthralgia**.

لأنه الرصاص بنافس الكالسيوم على كل ال binding sites ال بالجسم و بروح يرتبط فيها بداله ف
بخرّب ال release of neurotransmitters و بخرّب ال contraction of skeletal muscles

- Collapse precedes death.

Shock » dehydration, electrolyte imbalance, end organ damage » death

Management

Emesis

الذي هو ال induced
vomitting مفيد بحالة ال
recent exposure بس مش
كثير recommended لانه
يمكن يعمل aspiration

Gastric lavage with magnesium or sodium sulphate

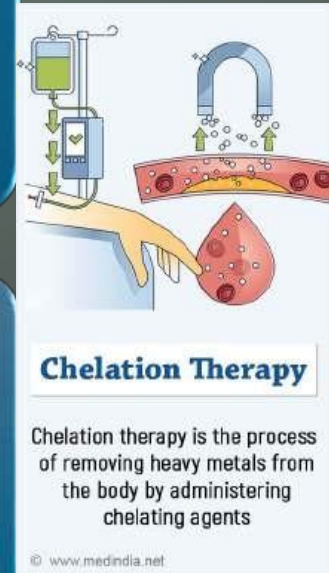
اكثر اشى efficient خلال ساعة
لساعتين من ال exposure

Calcium gluconate

بستخدمه بحال ال severe
poisoning لما تبلش تظهر
CNS symptoms، ممكن
يعمل seizures

Chelating agents: DMSA, EDTA, BAL, Penicillamine

مواد يرتبطوا بالرصاص و
هو موجود بالدم و بيعملوا
complex مع بعض الجسم
بتخلص منها بال urine



Chronic Poisoning (Plumbism, Saturnism or Saturnine Poisoning)

1

low dose consumption from drinking water supplied through lead pipes, food preserved in tin containers having lead lining, food contaminated with lead in the course of preservation

2

industrial environment due to inhalation of lead dust or lead vapour arising from burning of paints, battery,

3

Poisoning may occur due to prolonged use of vermilion and cosmetics containing lead, Absorption of tetra-ethyl lead through skin is common in people who handle petrol or gasoline.

Clinical Features

- Facial Pallor (early), due to vasospasm of capillaries
- Colicky pain (early)
 - characteristics: spasmodic, intermittent and relieved by pressure, associated with constipation
- Lead palsy (late): Muscle paralysis or weakness especially in hands and feet
 - Lead induced peripheral demyelination is reflected by prolonged nerve conduction time and subsequent paralysis, usually of extensor muscles of the hands and feet (wristdrop and footdrop).

Clinical Features

- Lead Encephalopathy :

- more common in poisoning by **tetraethyl lead**.
- it is frequently encountered in children.
- this may be due to inactivation of monoamine oxidase due to combination of lead with the **SH** radical of the enzyme.
- causes changes in personality, convulsion, delirium and coma.

Irritability, mood swings, behavioral changes

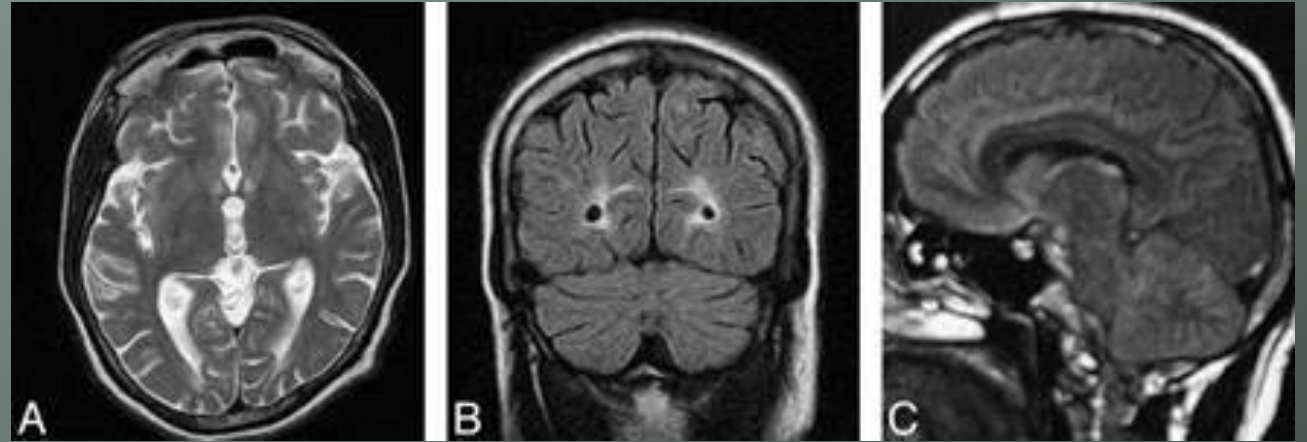
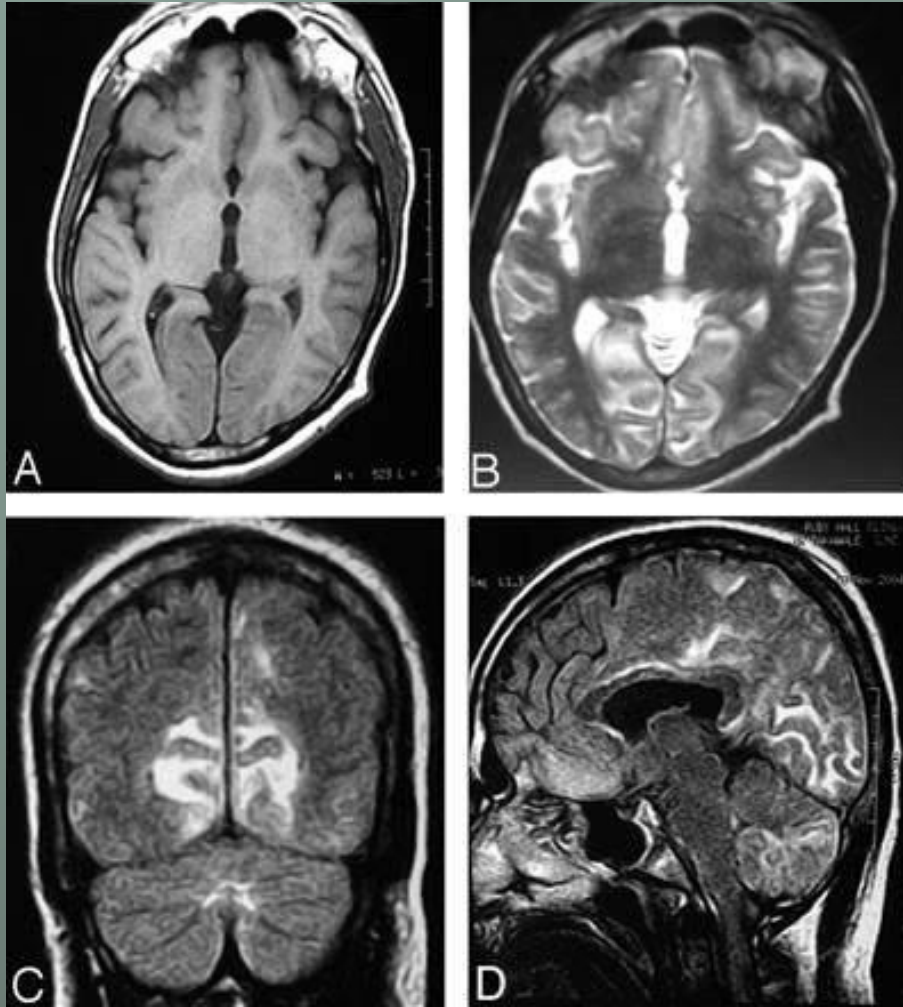
Disoriented, confused

كيف بصير ال encephalopathy ؟ عنا انزيم ال monoamine oxidase المسؤول عن تكسير بعض ال neurotransmitters زي ال dopamine and serotonin، في group بهاد الانزيم اسمه ال SH radical الي هو عبارة عن sulfa group المسؤولة عن ال activation لهاد الانزيم الي بصير انه الرصاص يرتبط بهاد ال group و ييمنع ال activation لل MAO فبتصير هاي ال neurotransmitter تتراكم بالدماغ و بتعمل exitment toxicity، الرصاص نفسه بعمل damage بال BBB بالتالي بصير في cerebral edema, increased ICP, inflammation و الرصاص كمان ينتج reactive oxygen species الي بتعمل neuronal damage و كل هاي الامور بتادي ل encephalopathy

Prechelation
MR imaging

مناطق ال hyperintensity هي المناطق التي فيها
رصاص و هاي finding دليل على lead neurotoxicity

Postchelation
MR imaging



Clinical Features

- Lead osteopathy:

- In children, lead is deposited beyond the **epiphysis** of the growing long bones.

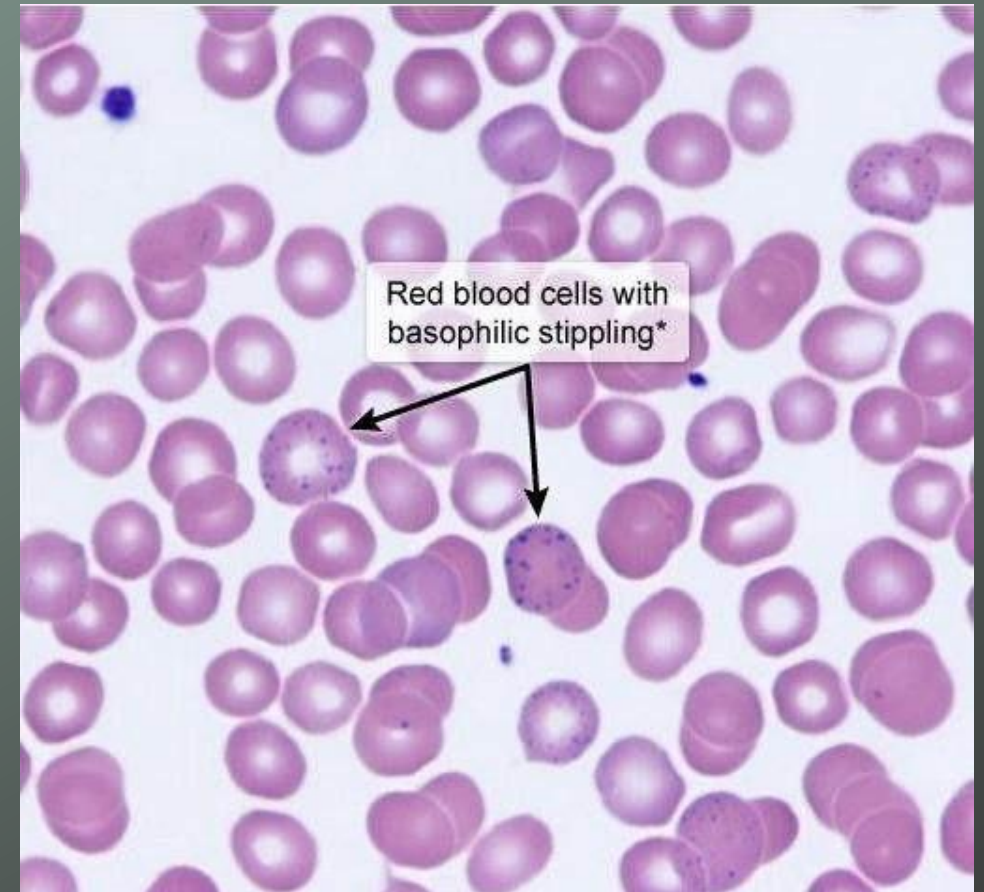
The **deposition is promoted by calcium and vitamin D** and is detectable by radiological examination in the form of increased density at the metaphyseal plate of growing long bones.



Clinical Features

Anaemia with Punctate Basophilia:

- It is due to **impairment in the synthesis of heme** from protoporphyrin and of porphobilinogen from δ -aminolaevulinic acid.
- The **basophilic stippling** of the red cells is due to condensation of iron containing ribonucleic acid near the mitochondria.



Clinical Features

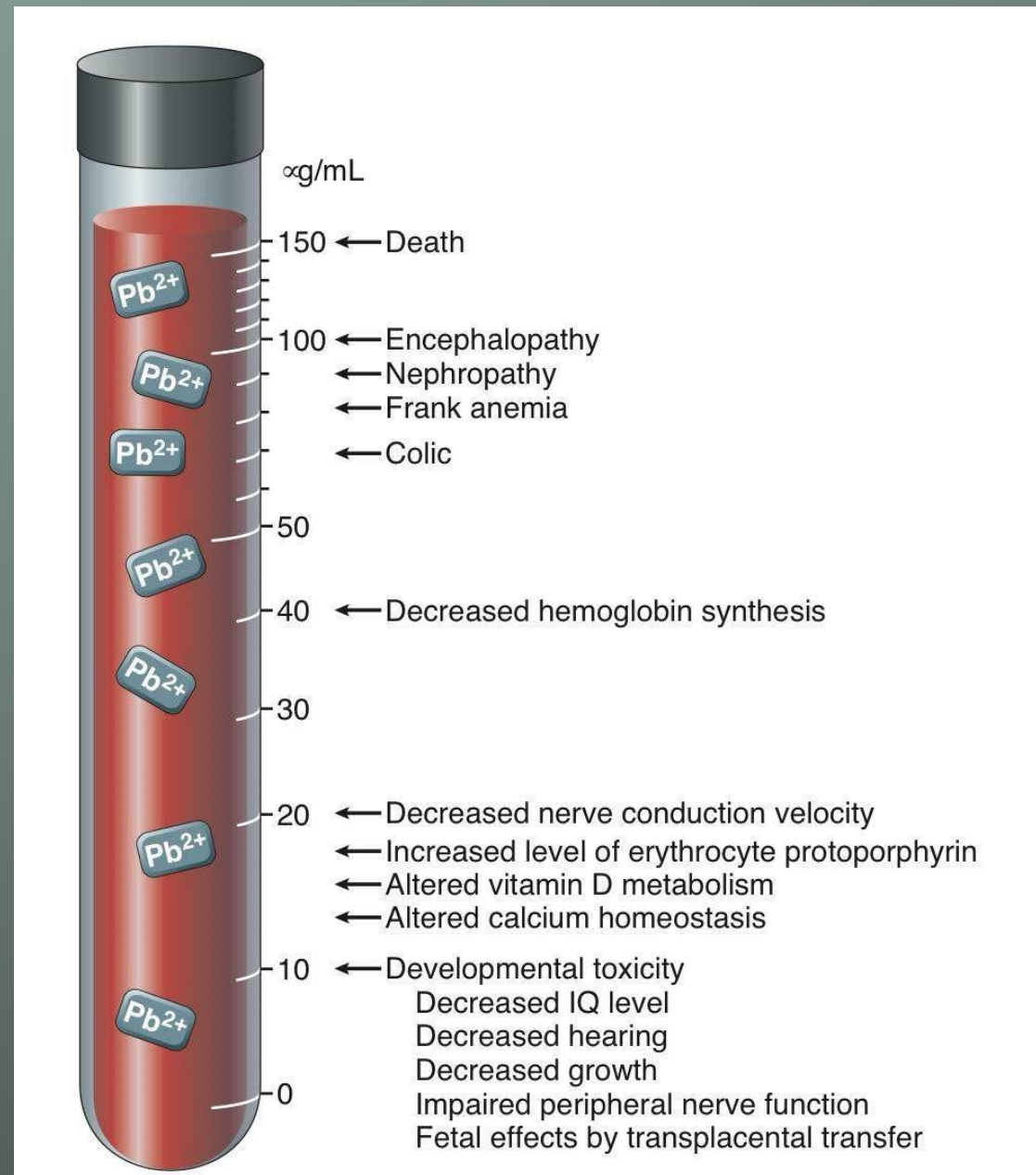
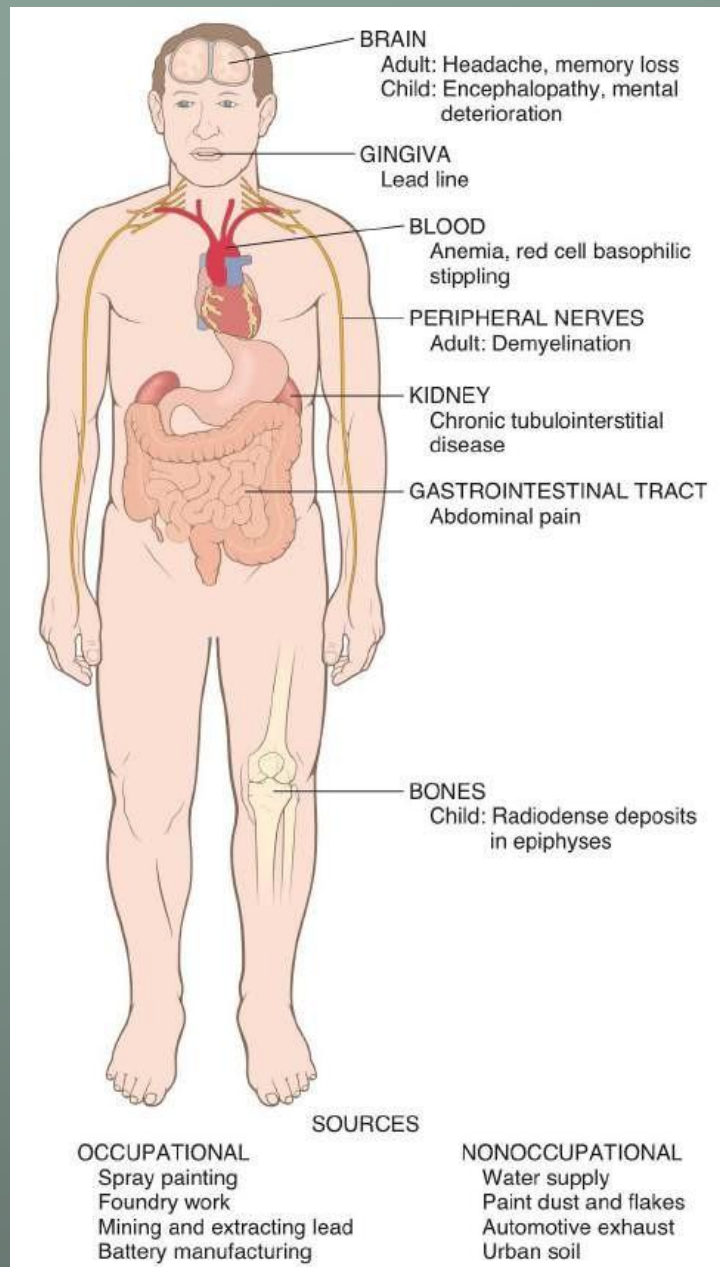
Lead line or **Burtonian line**:

- Is a bluish-black discolouration due to **subepithelial deposition** of lead sulphide granules on the gums at the **junction with the teeth**.
- It is seen in not more than 50% of cases, in whom dental hygiene is poor.



Clinical Features

- Retinal stippling.
- Effects on Circulatory System.
 - Like Anemia, inhibition of heme synthesis, increase BP
- Effects on Reproductive System.
 - Like infertility, reduce sperm count, menstrual irregularities



Diagnosis

- **Blood investigations:**

- Normal range of level of lead is 0–50µg/dl.
- Anaemia and basophilic stippling.

- **Urine investigations**

- Lead above 100 mg/L.
- Aminolaevulinic acid (ALA).

- **X-ray examination**

- Abdominal X-ray
- X-ray of the long bones

Management

- **Chelating agents** need to be administered depending upon the indications as written earlier.
- **Chelation is recommended for :**

Children → blood lead levels are $>55\mu\text{g/dl}$.

Adults → blood lead levels exceed 80 mg/dl or if these levels exceed 60mg/dl and symptoms have developed.

Medico-legal Aspects

- Children often have a craving for eating inedible things such as mica and often lick lead-based flakes of lead paints.
- Infants may suffer from slow and progressive lead poisoning by imbibing lead secreted in the milk of the mother.
- Suicidal and homicidal uses are very rare.
- Lead may be used criminally as an abortifacient.

Autopsy Findings

- Changes in the central nervous system, e.g : cerebral edema, atrophy.
- Presence of lead in various tissues and organs, especially bones, liver, and kidneys.
- Microscopic examination may reveal characteristic changes such as basophilic stippling in red blood cells.

Test yourself 😊

This X-ray image depicts a marked increase in the radiodensity of the epiphyses, resulting from impaired remodeling of calcified cartilage in the wrist epiphyses.

- **What causes this condition?**
- **What is the proper management?**



Test yourself 😊

- 1) In the context of lead poisoning, **name this sign.**
- 2) Describe the significance of this sign in the diagnosis of lead poisoning and how it appears on physical examination.



Thank You